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DISPERSAL AND MORTALITY IN THE PIED CORMORANT IN WESTERN AUSTRALIA

By JULIAN FORD, Attadale.

A ringing programme on the Pied Cormorant, *Phalacrocorax varius* (Gmelin), was commenced in Western Australia in 1960 for the purpose of obtaining information on its movements and seasonal mortality. The results of this investigation on these hitherto little known aspects of the life history of the species form the basis of this contribution.

METHODS

Twenty-four recoveries from 100 Pied Cormorants ringed as nestlings on Middle Shag Island, in Shoalwater Bay, on July 3, 1960, and six recoveries from 200 nestlings ringed on East Beagle Island, 39 miles south of Port Denison, on May 26, 1961, are analysed. The birds were ringed with C.S.I.R.O. aluminium bands ovalised so as to fit neatly around the tarsus.

MOVEMENTS

Dispersal from Shag Island

Within two months of being banded, Shag Island cormorants were recovered at the Mandurah estuary and Peel Inlet, where 11 recoveries were made during the first year (see Fig. 1), mostly in the August/November period (see Fig. 2). Three recoveries within the first year were also obtained from the vicinity of Fremantle and the Swan River estuary. These band returns (14% of the total banded and 58.3% of the total recovered) indicate that a good number of young Pied Cormorants fledged at Shoalwater Bay move into the fairly sheltered waters near Perth and Mandurah.

Some first-year birds undertook relatively long movements both north and south of Shag Island, the limits being 215 miles north to Port Denison and 140 miles south to Manjimup. There were 4 (16.7% of the total recovered) such returns.

Second-year recoveries (5% of the total recovered) were all within 25 miles of Shag Island. Two were from the Harvey estuary and two from the Swan River estuary, both localities being favoured feeding stations of the species.

Dispersal from the Beagle Islands

Only four band returns (2% of total banded) were obtained during the first year. No birds were recovered north of the Beagle

Islands, but to the south birds travelled as far as the Harvey estuary, 215 miles away. One was found at the banding site.

The two recoveries in the second year were at the banding station and 25 miles to the south.

Occurrence Inland

Two inland recoveries were made. An individual was recorded on October 4, 1960, at Carmel, 20 miles from the coast, and another was shot on November 6, 1960, at Manjimup, 30 miles inland and

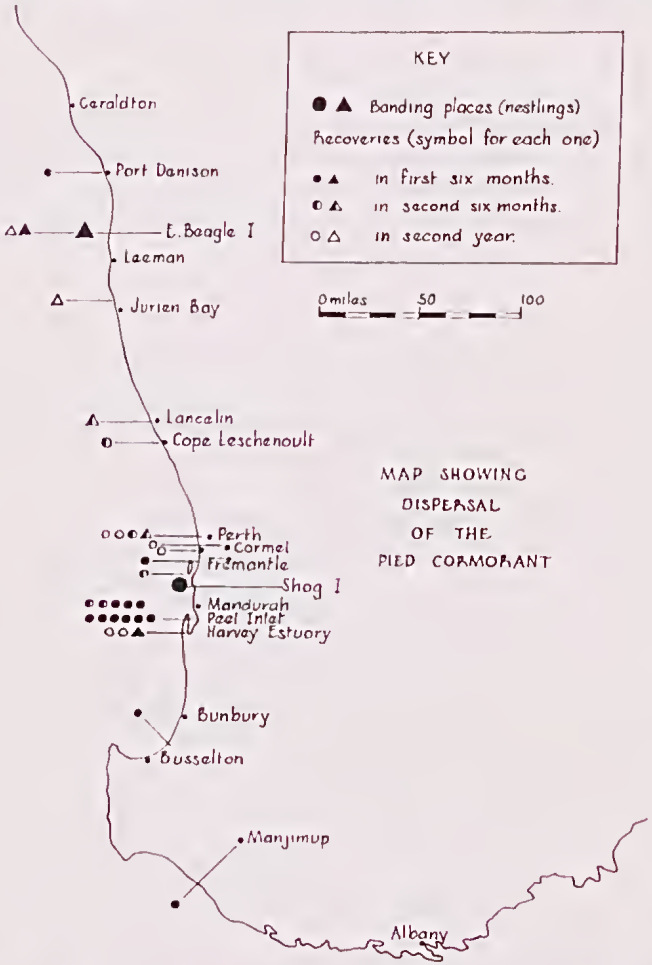

Fig. 1.—Places of banding and recovery of Pied Cormorants, *Phalacrocorax varius*, during 1960-1962. The largest symbol is the banding place of nestlings. Each small symbol indicates a reported band. Solid symbols are birds recovered in the first six-months, half solid symbols are birds recovered in the second six-months, and open symbols are birds recovered in the second year. Circular symbols indicate birds banded at Middle Shag Island on July 3, 1960, and triangular symbols indicate birds banded at East Beagle Island on May 26, 1961.

140 miles SSE of the banding place. The bird seen at Carmel was feeding on tadpoles and fresh-water crustacea at a dam, and was later recovered at Peel Inlet on March 8, 1961. These inland occurrences are somewhat unusual because in south-western Australia the Pied Cormorant favours the coastline and inlets.

MORTALITY

Seasonal distribution of recoveries is plotted in Fig. 2. It can be seen that practically all recoveries were made during the spring/summer period and that the peak falls during the September/November period. Eleven birds were recovered dead, five were taken alive, and data on the remaining fourteen returns were insufficient for a complete analysis although probably most of these were dead. Since 24 recoveries were from the 100 nestlings banded at Shag Island, it appears mortality in immature birds is very high; this is in agreement with findings on other species of marine cormorants (Kortlandt, 1942; Coulson and White, 1957). The high death toll in young birds is probably mainly due to inexperience, particularly with man, since many deaths are caused by birds being caught in fishing nets, etc., and to their being shot, but data are too meagre for any accurate analysis.

The low recovery rate of Beagle Island birds and long distance travellers from the Shag Island colony may be partly attributed to

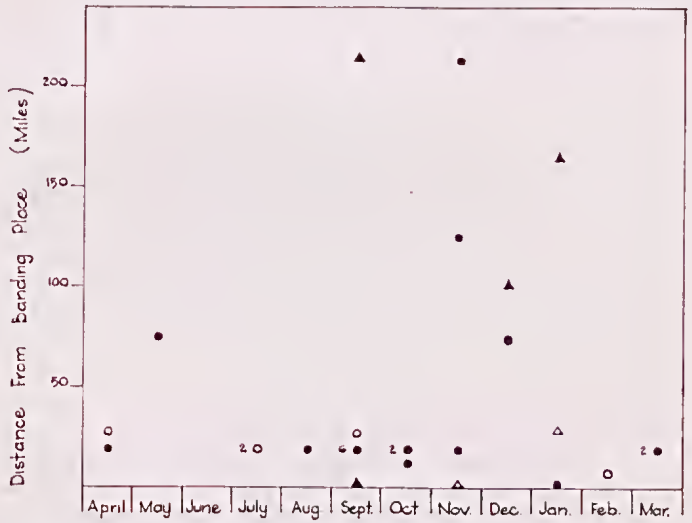

Fig. 2.—Seasonal distribution of recoveries of Pied Cormorants, *Phalacrocorax varius*, banded as nestlings in Western Australia during 1960-62. Each symbol represents a reported band except when accompanied by a figure in front of a symbol which gives the number of individuals recovered. Solid symbols are birds recovered in the first year, and open symbols are birds recovered in the second year. Circular symbols indicate birds banded at Middle Shag Island on July 3, 1960, and triangular symbols indicate birds banded at East Beagle Island on May 26, 1961.

the remoteness of much of the coastline, particularly north of Perth, from dense human population. A bias may also exist in the time of recovery of birds since during the spring/summer period there is a greater concentration of people on beaches and at inlets.

DISCUSSION

Investigations on the dispersal of marine cormorants in Europe and North America have shown that the longer movements are mainly undertaken by young birds, the adults usually remaining all the year in an area not too remote from their breeding place (Coulson, 1961; Palmer, 1962). Young birds usually disperse radially along coastlines from their place of hatching. Such movement patterns are exhibited by the Great or Black Cormorant *(P. carbo)* and the European Shag *(P. aristotelis)*. The distribution of recoveries of the Pied Cormorant shows that first-year birds of this species likewise disperse over the greater distances, and that older birds (second-year) remain within fairly close proximity of their natal area. Thus it appears that like the Black Cormorant and European Shag, the Pied Cormorant breeds at or near its birthplace.

This raises the question of how much interbreeding occurs between neighbouring populations. In the case of the Abrolhos Islands population, Serventy (1940) has suggested that the 40 miles between these islands and the mainland preclude much interchange of populations among this essentially inshore species and the fact that the Abrolhos birds breed in the spring while the mainland birds breed in the autumn serves as a double form of isolation. If the majority of Pied Cormorants do actually return to an area near their birthplace to breed, then the likelihood of much gene-interchange between the two populations appears to be still less. This behaviour would also tend to restrict gene-flow between neighbouring breeding populations on the mainland. Even if birds which survive to breed do so 25 miles from their birthplace, the present limit of second year recoveries, the amount of interchange so produced would appear to be rather small. In spite of this restricted gene-flow as indicated by these recoveries the species throughout its wide range in Australia and New Zealand has maintained a remarkably uniform morphology (cf. Condon, 1951), although Serventy (1940) recognised a race at the Abrolhos Islands.

On the west coast, the same offshore island is not used as a breeding ground every year, frequent shifts being made although usually only over short distances; my field observations have revealed transfers ranging from a few hundred yards to about 15 miles. For example, in 1960 the only site apparently used for breeding purposes between Leeman and Jurien Bay was Lipfert Island, but in 1961, only Sandland Island, about 15 miles south, was utilized. Whether such shifts in breeding location play an important role in facilitating the intermingling of populations is purely speculative for it is not known if breeding populations move as a unit or not, although the former seems the most likely on present evidence.

Owing to the fact that no data on the sex of recovered cormorants were obtained, no light can be thrown on the problem opened

up by White (1916) and Serventy (1939), that samples of birds collected in different areas show striking disproportions in the sex ratio. Serventy offered the tentative explanation that females wander farther from the nesting stations than do the males. It would be desirable to have the sex determined of recovered banded birds for the elucidation of this interesting phenomenon.

SUMMARY

An analysis of 30 banding recoveries of Pied Cormorants *(Phalacrocorax varius)* ringed as nestlings in Western Australia has revealed the following life history:

(1) In their first year of life, cormorants disperse randomly along coastlines and up estuaries for distances up to 200 miles from their natal area. (2) Inland occurrences are rare. (3) Most birds in their second year return to an area relatively close to their birthplace. However, further banding is necessary to confirm this. (4) Mortality is high in immature birds and consequently probably low in adults.

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CHECK LIST OF WESTERN AUSTRALIAN SCORPIONS

By L. GLAUERT, Western Australian Museum, Perth.

Three families of scorpions are represented in the fauna of Western Australia, the Scorpionidae, the Buthidae and the Bothriuridae; of these the first two have a wide distribution in tropical and subtropical regions but the third is confined to Australia and South America.